



# Association of Evening Chronotype with Poor Control of Type 2 Diabetes: Roles of Sleep Duration and Insomnia Level

Sima Hashemipour<sup>1</sup>, Zohreh Yazdi<sup>1,\*</sup> and Niloofar Mahabad<sup>1</sup>

<sup>1</sup>Metabolic Diseases Research Center, Research Institute for Prevention of Non-Communicable Disease, Qazvin University of Medical Sciences, Qazvin, Iran

\*Corresponding author: Metabolic Diseases Research Center, Qazvin University of Medical Sciences, Qazvin, Iran. Email: [dr.zohrehyazdi@gmail.com](mailto:dr.zohrehyazdi@gmail.com)

Received 2019 November 26; Revised 2020 August 16; Accepted 2020 August 17.

## Abstract

**Background:** Evening chronotype is usually associated with insomnia and short sleep duration.

**Objectives:** To investigate the independent association of chronotype with diabetes control.

**Methods:** In this cross-sectional study, 140 patients with type 2 diabetes were studied. The insomnia score was examined by a 7-item questionnaire. Also, chronotype was assessed by a 19-item questionnaire, and using the questionnaire, the patients were divided into three groups of morning, intermediate, and evening. This questionnaire has been developed for evaluating the preference for performing mental and physical activities at a special time of day. The Multivariate hierarchical analysis was applied for investigating the independent association of chronotype and glycated hemoglobin (HbA1c).

**Results:** The fasting blood glucose and HbA1c levels were significantly different across all the three chronotype groups such that it had the highest value in the evening group and the lowest value in the morning group (FBS =  $164.5 \pm 34.1$  mg/dL and HbA1c =  $8.7\% \pm 1.7$ , in the evening group, and FBS =  $132.7 \pm 23.1$  mg/dL and HbA1c =  $6.9\% \pm 0.4$  in the morning group,  $P < 0.001$ ). The morning group had longer sleep duration and less insomnia than other groups. Results of the hierarchical regression analysis showed that the chronotype explained 28.4% of the variance of HbA1c. Results of the final model demonstrated that the chronotype had a relationship with HbA1c, independent of body mass index (BMI), time of going to bed, and insomnia score.

**Conclusions:** Evening chronotype is associated with poorer control of diabetes, independent of BMI and sleep variables.

**Keywords:** Chronotype, Glycemic Control, Insomnia

## 1. Background

Human beings have significant individual differences in their circadian rhythm. In the meantime, one of the most important differences is morning-evening preferences. The morning individuals tend to fall asleep in the early hours of the night and prefer the first half of the day to perform physical and mental activities. On the contrary, evening individuals tend to perform the activities in the evening and at night; these individuals fall sleep in the late hours of the night or at midnight. The third group, the intermediate individuals, is between these two ends of the spectrum (1). Determinants of chronotype are numerous. The circadian system, age, sex, genetics, geographical area of life, and unknown variables are among factors affecting the chronotype (2).

Most of the body's hormones are affected by the circadian rhythm. The secretion of cortisol hormones, growth hormone, and prolactin is closely associated with sleep time, and changes in these hormones can cause metabolic effects (3, 4). The correlation of chronotype with the in-

cidence and control of diabetes has been examined in a few studies. In a study in Finland (5), the evening chronotype was associated with a 2.5-fold increase in the incidence of type 2 diabetes. In other studies, the relationship between diabetes control and chronotype has been reported. In most of these studies, the evening chronotype is associated with higher HbA1c (6-9). In addition to the chronotype, sleep quality and sleep duration also affect metabolic health. Short nighttime sleep and poor sleep quality are associated with the increased probability of insulin resistance, risk of type 2 diabetes, as well as poorer glycemic control in patients with diabetes (10-13).

In most studies, the evening chronotype is associated with a shorter duration and lower quality of sleep (14, 15). Most of these studies have focused on sleep quality rather than insomnia score, and to the best of our knowledge, no study has evaluated specifically the association of evening chronotype with poor control with respect to insomnia level. Considering the above-mentioned studies, both chronotype and sleep duration are associated with